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| Re Applic of | David R. Medeiros, et al. |
| Docket No. | FIS920030159US1 |
| Serial No. | 10/604,082 |
| Filing Date | 6/25/03 |
| Attorney | Steve Capella |

Attached: Appeal Brief

**PLEASE DELIVER TO: Daborah Chako-Davis**
**EXAMINER: ART UNIT: 1752**
**CONFIRMATION NO.: 1081**
**PHONE NO:**
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| TRANSMITTAL OF APPEAL BRIEF (Large Entity) | Docket No. FIS920000159US1 |
|---|---|

In Re Application Of: **David R. Medeiros, et al.**

| Application No. | Filing Date | Examiner | Customer No. | Group Art Unit | Confirmation No. |
|---|---|---|---|---|---|
| 10/604,082 | 6/25/03 | Daborah Chako-Davis | 32074 | 1752 | 1081 |

Invention: **PROCESS FOR FORMING FEATURES FO 50 NM OR LESS HALF-PITCH WITH CHEMICALLY AMPLIFIED RESIST IMAGING**

COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

The fee for filing this Appeal Brief is: **$500.00**

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☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

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*Signature*

Dated: **October 5, 2005**

**Steve Capella**
**Attorney for Applicants**
**Reg. No.: 33,086**

I hereby certify that this correspondence is being sent via facsimile on October 5, 2005 and is addressed to "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450" [37 CFR 1.8(a)] on

October 5, 2005
*(Date)*

10/5/05

*Signature of Person Mailing Correspondence*

**Teri McDonald**

*Typed or Printed Name of Person Mailing Correspondence*

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I hereby certify that this correspondence is being deposited by FACSIMILE to the Commissioner of Patents, PO Box 1450, Alexandria, VA 22313-1450 on October 4, 2005 by Teri McDonald.

Teri McDonald 10/5/05



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit 1752

| | | |
|---|---|---|
| In re application of | : | October 5, 2005 |
| David R. Medeiros et al. | : | Examiner: Daborah Chako-Davis |
| Serial No.: 10/604,082 | : | |
| Filed: June 25, 2003 | : | IBM Corporation<br>Dept. 18G/Bldg. 300-482 |
| Title: PROCESS FOR FORMING FEATURES OF 50NM OR LESS HALF-PITCH WITH CHEMICALLY AMPLIFIED RESIST IMAGING | : | 2070 Route 52<br>Hopewell Junction, NY<br>12533-6531 |

## APPEAL BRIEF

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

This is an appeal from the Final Rejection of claims 1, 2, 4, 5, 7, 9-11, 13-16, and 18-20. A correct copy of the claims is attached in the Appendix.

## Real Party in Interest

The real party in interest is International Business Machines Corporation per an assignment recorded in the US Patent and Trademark Office at Reel/Frame: 014860 / 0424 on December 29, 2003.

## Related Appeals and Interferences

None.

## Status of Claims

Claims 1, 2, 4, 5, 7, 9-11, 13-16, and 18-20 are pending. Claims 3, 6, 8, 12 and 17 have been canceled. There are no other claims in the application.

## Status of Amendments

The amendment after Final Rejection submitted on July 11, 2005 is to be entered per the Advisory Action dated August 2, 2005. The appended claims and Status of Claims reflect such entry.

## Summary of the Claimed Subject Matter

The invention centers on methods of forming sub-50nm pitch features using lithography. The invention is characterized by the use of resist having low activation energy acid labile protecting groups (specifically, ketals, acetals and orthoesters) and by the use of a controlled low temperature post-exposure treatment (temperature and time combination). This combination allows for the creation of such fine features while avoiding blur. See the specification at paragraphs [0009] and [0045].

## Grounds of Rejection to be Reviewed on Appeal

1. Claims 1, 2, 4, 5, 7, 9-11, 13-16, and 18-20 are rejected under 35 USC 103(a) as being unpatentable over US Patent Application Publication No. 2003/0182534 A1 (Varanasi et al.) in view of US Patent No. 6,399,273 (Yamada et al.).

## Argument

Varanasi et al. (US 2003/0182534 A1) discloses a process using photoresist which may contain low activation energy protecting groups. Varanasi et al. uses a conventional post-exposure bake step of involving treatment at 100°C or greater. While Varanasi et al. references a feature size of 130nm or less, the smallest feature size actually resolved in Varanasi et al. is on the order of 150nm. Varanasi et al. does not disclose or suggest the claimed combination of using a photoresist of low activation energy and mild post-exposure treatment presently claimed, nor the results associated with such combination, namely the ability to resolve features at 50 nm half pitch. Appellants submit that while Varanasi et al. mentions the capability of producing features of less than 130nm, this is not the same as saying that Varanasi et al. enables (alone or in combination with Yamada et al.) or even contemplates features at 50nm half pitch which is, in semiconductor lithography terms, at least three manufacturing generations advanced of 130nm technology.

Yamada et al. (US 6,399,273) discloses specific photoresists which are thermally treated prior to exposure where the photoresists have improved etch resistance. Yamada et al. discloses a lithography process using a post-exposure bake condition of at least about 60°C, more preferably at least about 100°C. The temperatures actually used in the examples of Yamada et al. are at least 120°C. The features resolved in the examples of Yamada et al. are on the order of 1000 nm. Further, appellants submit that the temperatures actually used by Yamada et al. correspond to those normally used in the art. Thus, one of ordinary skill would not consider Yamada et al. as providing any special instruction regarding post-exposure bake conditions, much less that one would be able to use the unconventional conditions of the invention as part of a combination of process features which enable sub-50nm pitch resolution. Yamada et al.'s disclosure of

"about 60°C" is not the same as disclosing or suggesting the use of a 50°C bake especially where the temperatures exemplified by Yamada et al. are well above 60°C and that the primary purpose of post-exposure baking is to provide sufficient energy to drive the deprotection reaction further to completion. Thus, appellants submit that the combination of Yamada et al. with Varanasi et al. would still result in the use of a post-exposure treatment at temperatures exceeding the claimed range. The combination of Yamada et al. with Varanasi et al. would still fail to disclose or suggest the claimed combination of using a resist of low activation energy with a mild post-exposure treatment or the results of such combination, namely the ability to resolve features at 50nm half pitch.

For these reasons, appellants submit that the appealed claims are patentable over US Patent Application Publication No. 2003/0182534 A1 (Varanasi et al.) in view of US Patent No. 6,399,273 (Yamada et al.).

## Conclusion

Based on the above arguments, appellants submit that the present claims are patentable over the prior art of record and that the rejection under 35 USC 103(a) should be reversed.

Respectfully submitted,
David R. Medeiros et al.

By _____
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## Appendix

## Claims on Appeal

1. A method of forming a material structure on a substrate, said material structure having a pattern containing features having a half-pitch of about 50nm or less, said method comprising:
   (A) providing a substrate with a layer of said material,
   (B) applying a positive tone resist composition to said substrate to form a resist layer on said substrate, said resist composition comprising (a) an acid-sensitive imaging polymer matrix, and (b) a radiation-sensitive acid generator, said imaging polymer comprising a pendant acid-labile moiety selected from the group consisting of ketals, acetals and orthoesters,
   (C) patternwise exposing said substrate to radiation whereby acid is generated by said radiation-sensitive acid generator in exposed regions of said resist layer,
   (D) treating the exposed resist layer with a deprotection reaction-dependent co-reactant at a temperature of about 20-50°C for about 1 to 30 minutes to promote acid-catalyzed reaction in exposed portions of said resist layer but not so long as to cause resolution degradation due to acid diffusion-induced blur,
   (E) developing a patterned resist structure in said resist layer by removing radiation exposed portions of said resist if said resist is a positive tone resist, and
   (F) transferring resist structure pattern to said material layer by removing portions of said material layer through spaces in said resist structure pattern.

2. The method of claim 1 wherein said material is selected from the group consisting of organic dielectrics, metals, ceramics, and semiconductors.

4. The method of claim 1 wherein said transfer of step (F) comprises reactive ion etching.

5. The method of claim 1 wherein at least one intermediate layer is provided between said material layer and said resist layer, and step (F) comprises etching through said intermediate layer.

7. The method of claim 1 wherein said deprotection reaction dependent co-reactant is present in the polymer film during exposure.

9. The method of claim 1 where water is employed as co-reactant.

10. The method of claim 1 wherein said exposure of step (C) is done under anhydrous conditions.

11. The method of claim 9 wherein the treatment of step (D) is performed in a water vapor-containing atmosphere having a relative humidity of about 10 to 80%.

13. The method of claim 1 wherein step (D) is conducted for about 1 to 5 minutes.

14. The method of claim 1 wherein said radiation used in step (C) has a wavelength selected from the group consisting of 248 nm, 193 nm, 157 nm, 13.4 nm, 1.4 nm, and 1.1 nm.

15. The method of claim 1 wherein said radiation used in step (C) is extreme ultraviolet.

16. The method of claim 1 where said radiation used in step (C) is selected from the group consisting of with electron beam and ion beam.

18. A method of forming a material structure on a substrate, the material structure having a pattern containing features having a half-pitch of about 50nm or less, the method comprising:

(A) providing a substrate,

(B) applying a positive resist composition to the substrate to form a resist layer on the substrate, the resist composition comprising (a) an acid-sensitive imaging polymer matrix, and (b) a radiation-sensitive acid generator, the imaging polymer matrix comprising a pendant acid-labile moiety having a low activation energy for acid-catalyzed cleaving,

(C) patternwise exposing the substrate to radiation whereby acid is generated by the radiation-sensitive acid generator in exposed regions of the resist layer,

(D) post-exposure processing of the exposed resist layer in the presence of a de protection reaction-dependent co-reactant at a temperature of about 20-50°C for about 1 to 30 minutes to promote the acid-catalyzed reaction in exposed portions of the resist layer but not so long as to cause resolution degradation due to acid diffusion-induced blur,

(E) developing a patterned resist structure in the resist layer by removing radiation exposed portions of the resist, and

(F) transferring resist structure pattern to the material by depositing the material onto the substrate at spaces in the resist structure pattern.

19. The method of claim 18 wherein said deposition of step (F) is done by electroplating, chemical vapor deposition or physical vapor deposition.

20. The method of claim 9 comprising providing a water-containing atmosphere at about 30 to 60% relative humidity.